

one basic furnace and then transferring the metal, but not the slag, to a second furnace, completing the purification and finishing the steel in the second furnace. The slag of the primary furnace is valuable, and the removal of the phosphorus before the carbon is a great advantage. This process has met with considerable success. In 1898 Talbot introduced his continuous process, which is so well known that it need hardly be described.

In 1900 Monell patented a process which has come into considerable public prominence owing to a recently decided law case with regard to its alleged infringement. In certain circumstances the amount of scrap required for the ordinary working of the basic open-hearth process is not easily obtained, and although by the ordinary process an all-pig charge may be successfully worked, the time occupied in getting rid of the large quantity of impurities increases the length of time necessary for purification, and hence decreases the output of a furnace of a given size. Monell charges on to the bottom of the open-hearth the usual quantity of limestone which was employed in a furnace of like capacity with charges of half pig and half scrap. But along with this limestone he charges an amount of oxide of iron, generally in the form of iron ore, equal to about 20 per cent. of the weight of the pig-iron it is proposed to treat. These materials are heated to a red heat, and whilst still unfused the charge of pig-iron in the molten condition, either direct from the blast furnace or from a metal mixer, is poured into the furnace as rapidly as possible. This causes an active reaction, and the materials being at a comparatively low temperature the ore oxidises the phosphorus, silicon, and manganese in the pig-iron with extreme rapidity, and at the same time oxidises a portion of the carbon.

If the phosphorus in the original pig be not more than 0.80 per cent., in about one hour it will be reduced to less than 0.1 per cent., the carbon remaining being about 2 per cent. Eighty per cent. of the slag is now removed, leaving the metal only very thinly covered, and then oxide of iron is added to the bath and the carbon gradually reduced to the percentage required; so that by this means, in the basic furnace, a steel sufficiently low in sulphur and phosphorus is produced, and of any carbon desired, without the necessity of going down to a very low percentage of carbon, as in the ordinary process, and either being content to make only mild steel or to make special arrangements for carburising after removal of the slag (the Darby process). The yield by the Monell process is more than 100 per cent. of the metallic charge, owing to reduction of iron from the ore, the mean of about eighty consecutive trial heats being 108 per cent., but this is a feature not peculiar to this modification only. Unfortunately for the usefulness of the Monell process in this country, when the pig-iron contains from 1.5 per cent. to 2.0 per cent. phosphorus, as only about 80 to 90 per cent. of the total phosphorus is removed, too much remains in the metal at the end of the reaction to make the process valuable, and after the removal of the first slag, additions of lime and ore must be made as in ordinary working.

Improvements made in the basic process even since 1900 have rendered the application of the Monell process unnecessary in this country. Metal mixers, large vessels in which molten iron from the blast furnace is stored, were originally used mainly to obtain a more regular composition of iron for either the converter or the open-hearth process. Gradually these have developed in size from a capacity of about 70 or 80 tons up to the present day, when mixers of 200 to 600 tons capacity are used, and the metal-

mixer is now often gas-fired, so that the heat of the metal can be maintained for longer periods, and even cold pig-iron can be added. The metal mixer is now much used as a furnace for the preliminary purification of the molten cast-iron from the blast furnace. The modern metal mixers are lined with dolomite or magnesia, are gas heated, oxides of iron are added to the contents, and the blast-furnace metal made and cast into pigs during week-ends, and generally called week-end metal, can be melted in them. At the comparatively low temperature maintained in the mixers (about 1500° C.) silicon and phosphorus are partially eliminated, whilst the carbon is but little affected. The sulphur is decreased because of the length of time the metal is lying in a molten condition in the mixer, during which the manganese sulphide gradually floats to the top and is removed with the slag. The resulting metal is in good condition, and of suitable composition to be transferred to the ordinary basic open-hearth furnace and finished with a comparatively clean slag—that is, a slag not rich in phosphate.

From the results given by Mr. A. Windsor Richards in a paper to the Iron and Steel Institute recently, it would seem as if the basic Bessemer process had received, through the modification in its working designed by Dr. Massenez, an efficient tonic in its desperate struggle with the open-hearth process. By this modification the ordinary high-silicon low-sulphur Cleveland pig (c), made from native ores, is poured in a molten condition into a basic lined converter, into which has been previously placed iron ore, with a small quantity of lime. The blow is continued until the carbon flame appears and all the silicon is oxidised, when the converter is turned down and the slag is carefully removed, this slag containing 35 to 45 per cent. silica and practically no phosphate. The linings are not affected because of the short time during which this slag is acting, and also because of the comparatively low temperature. The charge is then finally blown in the ordinary way, giving a slag containing 14 to 20 per cent. of phosphoric anhydride, 95 per cent. of which is in the soluble condition. The addition of oxide distinctly improves the yield, and the process is said to be working thoroughly successfully. Week-end metal is cast into pig beds and put on the market for foundry purposes, which cannot be done with basic pig (b), as it is only suitable for conversion into steel by the basic process.

A. MCW.

#### NOTES.

PROF. T. G. BONNEY, F.R.S., will be the president of the British Association at the meeting to be held at Sheffield next year.

WE have to announce, with deep regret, that Dr. Arthur Gamgee, F.R.S., emeritus professor of physiology, University of Manchester, and late Fullerian professor of physiology in the Royal Institution, died in Paris on Monday, March 29, at sixty-seven years of age.

THE Anthropological Society of Paris will celebrate the jubilee of its foundation on July 7-9 next. The society was founded in 1859 by Broca.

THE annual meeting of the German Bunsen Society of Applied Physical Chemistry is to be held at Aachen on May 23-26, immediately before the International Congress of Applied Chemistry in London. Among the subjects to be discussed is the application of physical chemistry to metallurgy.

THE Oliver-Sharpey lectures of the Royal College of Physicians will be given for this year by Prof. C. S. Sherrington, F.R.S., to-day, April 1, and to-morrow, at 5 p.m., at the Royal College. The subject of the lectures is "The *Rôle* of Reflex Inhibition in the Coordination of Muscular Action."

THE *Rendiconti del R. Istituto Lombardo* announces, under the prize awards of the society, a grant of 1000 lire to Dr. Umberto Savoia, for his studies in metallography, and a grant of 1500 lire to Prof. Ernesto Bertarelli, of Parma, for his work on syphilis. Among the subjects offered for the present and next year we notice Lie's theory of transformation groups, relations between the variations in wages and price of production, the colloidal state of matter, and the anatomy of the nervous system.

IN 1910 an exhibition, on an extensive scale, of the arts, sciences, manufactures, industries, and products of Great Britain and of Japan is to be held at Shepherd's Bush. The scheme is being supported by the Japanese Government, and the British Government is believed to be in sympathy with the project. Satisfactory arrangements have been concluded between the British organisers and representatives of the Japanese Department of Agriculture and Commerce.

IN NATURE of March 11 last (vol. lxxx., p. 47) attention was directed to the movement which is being organised by the British Empire League to provide London with a monument to Captain Cook. It was then pointed out that a general committee of distinguished persons had been formed, and that steps would be taken later to appoint an executive to collect the necessary funds, to determine the character of the memorial, and to select the best available site. A meeting of the general committee was held at the Mansion House on March 30 and elected an executive, on whom will devolve, in due course, the duty of issuing an appeal for funds and of taking the necessary steps for the erection of a memorial. The Prince of Wales has consented to become honorary chairman of the general committee, and Lord Brassey to undertake the duties of treasurer.

THE following are among the lecture arrangements at the Royal Institution after Easter:—Prof. F. W. Mott, two lectures on the brain in relation to right-handedness and speech; Prof. Svante Arrhenius, two lectures on cosmogonical questions (the Tyndall lectures); Prof. J. Garstang, two lectures on the Hittites, (1) monuments of Egypt and Asia Minor, (2) recent discoveries in Asia Minor and northern Syria; Dr. F. Gowland Hopkins, two lectures on biological chemistry; Mr. J. G. Millais, three lectures on Newfoundland; Prof. W. E. Dalby, two lectures on a modern railway problem, Steam *v.* Electricity; Mr. R. T. Günther, two lectures on the earth movements of the Italian coast and their effects; Dr. W. H. R. Rivers, two lectures on the secret societies of Banks' Islands; and Dr. F. F. Blackman, two lectures on the vitality of seeds and plants, (1) a vindication of the vitality of plants, (2) the life and death of seeds. The Friday evening meetings will be resumed on April 23, when Mr. Alexander Siemens will deliver a discourse on tantalum and its industrial applications. Succeeding discourses will probably be given by Major Ronald Ross, Prof. G. E. Hale, Dr. J. Emerson Reynolds, Prof. J. A. Fleming, and Sir James Dewar.

THE Royal Academy of Sciences and Letters of Denmark has issued a descriptive circular showing prize subjects proposed by it this year. In philosophy the subject is a

critical consideration of Socrates and his philosophic influence since the time of Aristotle. The problem in astronomy is to examine the conditions in which it is possible to determine the mass of a comet, and to investigate whether these conditions are satisfied by comets which do not traverse exactly the orbits calculated for them by the usual methods. It is required that for at least one comet of this class the orbit should be calculated using the whole of the seven constants of the formulæ relating to the movement of two bodies, and that the results obtained should be compared with those of observation. The prize in physics is for a study of the influence produced by pressure, temperature, and wave-length upon the index of refraction of substances in the liquid and gaseous states. A prize is offered also for a study of the changes undergone by calcium cyanamide in the course of its manufacture for purposes of agriculture and during its use as a fertiliser. In each case the prize is the gold medal of the academy, having a value of about 18*l.* The papers may be written in Danish, Swedish, Norwegian, English, French, or Latin, and must be sent in before October 31, 1910, in each case except that of physics, the closing day of which is one year later. Further particulars may be obtained from the secretary of the academy, Prof. H. G. Zeuthen, The University, Copenhagen.

THE most important article in the January issue of the *Annals of the Transvaal Museum* is one by Dr. L. H. Gough on the South African lizards of the genus *Agama*, in which the various species are re-described and illustrated from spirit-specimens.

PREHISTORIC Scandinavian implements, with special reference to the use of deer-antlers, form the subject of an illustrated article, by Mr. J. A. Grieg, in the March number of *Naturen*. Another paper on the same subject, by Prof. A. W. Brøgger, but devoted chiefly to stone implements, although also containing illustrations of incised figures of certain animals, appears in the third part of the *Bergens Museum Aarbog* for 1908. Attention is likewise directed to some of the more remarkable types of these implements by Dr. H. Schetelig, the director of the historical and antiquarian section, in the *Aarsberetning* of the same institution for 1908. According to the last-named publication, the Bergen Museum continues to make satisfactory progress in all departments, special attention being directed to the mounting of groups of animals in imitation of their natural surroundings in the zoological section.

WE have to acknowledge the receipt of vol. x. of the third series of the *Annales del Museo Nacional de Buenos Aires*, a volume bearing the date 1909, although the whole of the numerous articles, with the exception of the two last, were separately issued during 1908. Of these, two by Dr. Ameghino, one dealing with the edentate shoulder-girdle and the other with the supposed fossil armadillos of France and Germany, have been already noticed in our columns. We may here refer to a paper by Mr. J. Brethes on the nests of the Argentine spider known as *Mastophora extraordinaria*. These minute spiders construct nests in the form of some half-dozen circular chambers of the size of large peas, each attached to the surface, from which they hang by a slender pedicel. They are made of a substance resembling *papier-maché*, and in colour are white with numerous irregular black blotches. In the interior of each is deposited a cluster of eggs. The receptacles have a perfectly uniform structure, and show no signs of a closed-up entrance hole. The marvel is how the spider contrives to introduce her eggs into these closed chambers.



THE report of a committee appointed by the Royal Society of Medicine to consider the request of the chief surgeon of the Metropolitan Police on the best method of artificial respiration in the case of the apparently drowned was adopted by the council of that society in July last, and a copy of the report has just reached us. The committee was fully representative, and included surgeons, physicians, and physiologists; Sir William Church acted as chairman. The report is unanimous, and recommends the simple and safe method introduced by Prof. Schäfer in preference to the older and more risky methods of Sylvester and Marshall Hall. We learn with satisfaction that the report has been officially accepted for adoption throughout the metropolitan area. We can only hope this example will be followed in other quarters. For the sake of our readers who may not be acquainted with the Schäfer method, and one never knows when the occasion may arise for its employment, we may add a brief description of the process. The individual is laid on the ground in the prone position with a thick folded garment under his chest. The operator kneels athwart him, facing his head, and places his hands on each side over the lower ribs. He then slowly throws the weight of his body forwards, and thus presses upon the thorax of the subject and forces air out of the lungs; he then gradually relaxes the pressure by bringing his body up again, but without removing his hands. This is repeated regularly at the rate of twelve to fifteen times a minute until normal respiration begins or until all hope of restoration is given up; but it is best to persevere for at least an hour.

AN insect has appeared in Antigua that causes the dropping of the flower buds of cotton, and an investigation on the spot has been made by Mr. Ballou, whose preliminary report is published in a recent issue of the *Agricultural News*. The insect was found living on the wild cotton, and apparently on privet, and is now being further examined.

WE have received the current number of *Tropical Life*, a monthly journal devoted to those interested in tropical or subtropical countries. It contains several useful articles on important tropical crops, such as cacao, pea-nut, and sisal, as well as notes on appliances likely to prove useful on tropical estates. Market reports are also given, and general articles calculated to interest those whom the journal is designed to serve.

Now that the interest in breeding problems has become so widespread, it is very necessary to have some system of records by which the parentage of any particular individual breed during the experiment may be at once ascertained. The method adopted at the Rhode Island Agricultural Experiment Station for keeping pedigree records is described by Dr. L. J. Cole in the annual report of the station. It is a modification of Galton's method (*NATURE*, 1903, vol. lxi., p. 586), and is worked on the card-index system, giving each individual a separate card; the advantage claimed for it is that it enables the ancestors and the descendants of any individual to be traced with very little difficulty.

THREE bulletins from the United States Department of Agriculture Bureau of Entomology are to hand. Dr. Ball discusses (No. 66) the leaf-hoppers of the sugar-beet and their relation to the "curly leaf" condition. *Eutettix tenella* is described at length; illustrations and descriptions are also given of other species of *Eutettix*, of *Agallia*, and of a small green Empoasca. It is concluded that *Eutettix tenella* is responsible for one common kind of

"curly leaf." In No. 104 Dr. Chittenden deals with the red spider (*Tetranychus bimaculatus*), which is particularly injurious to violets, roses, melons, cucumbers, tomatoes, &c. This spider resists fumigation with tobacco or hydrocyanic acid more than many other insects, but it is destroyed by sulphur or soap solution. In Bulletin No. 344 Mr. W. D. Hunter deals, from the farmer's standpoint, with the cotton-boll weevil, which does a great amount of damage each year; the loss caused by the weevil since it invaded the States is estimated at 125,000,000 dollars.

THE influence of breed on egg-production in poultry is well seen in a report recently issued by Messrs. E. and W. Brown from University College, Reading. Danish, American, and English Leghorns were kept under comparable conditions for twelve months, and careful record was kept of the number of eggs laid. The Danish birds had been bred to yield a large number of eggs of moderate size; the English birds, on the other hand, had been largely bred for exhibition purposes, for which egg-producing capacity is not needed. The consequence is seen in the following table:—

	Danish brown Leghorns	American white Leghorns	English white Leghorns
Average number of eggs per bird... ..	153·7	142	76
Average weight of each egg... ..	2·12 oz.	2·34 oz.	2·05 oz.
Percentage of eggs weigh- ing less than 2 oz. ...	1·8	0·5	32·9

The profit on the English birds is shown to be much less than that on the Danish or American birds.

THE tenth report of the Woburn Experimental Fruit Farm follows closely on the ninth, and deals with the treatment of trees for insect pests. It was found that nursery stock could be freed entirely from woolly aphis by immersion for ten minutes in water heated to 115° F., at which temperature the plants did not suffer. Treatment with petrol was equally effective so far as the destruction of aphis was concerned, but might be likely to cause more damage to the plants. On the other hand, fumigation with hydrocyanic acid was both risky and uncertain, and is not recommended by the authors. Trees infested with aphis could be cleansed by spraying with light paraffins like petrol in the undiluted state, but their leaves suffer so much that the method should only be adopted in extreme cases. It is shown that injection of paraffin into the soil produces but little direct injury to the tree, and there seems the possibility that it might prove a useful method for killing the insects that harbour round the roots, and that do a good deal of harm by their migrations to the branches. Experiments were also made with nicotine, which was found to destroy *Psylla*, but not caterpillars. Paraffin emulsion, however, proved quite fatal to the caterpillars of the winter moth, the gooseberry saw-fly, and the currant saw-fly, and had the further advantage of not interfering with the sale of any fruit which might happen to be on the bushes at the time.

A SHORT practical pamphlet on lawns, prepared by Mr. W. J. Stevens, has been published in the series of "One and All" garden books. It contains the necessary information on the making of lawns with turf or with seed, renovation and manuring, also a list of suitable varieties of grass seed. It concludes with a few hints by Tom Hearne on cricket and tennis grounds.

It is now generally recognised that bakers prefer strong wheats, because the flour gives a more shapely loaf. Soft wheats have been recommended for Indian cultivation in

the past, but a trial of samples, recorded by Mr. A. Howard in Bulletin No. 41 of the Agricultural Research Institute, Pusa, reverses the verdict. Of ten samples, three hard wheats from the Punjab furnished good results, but they were excelled by a new hard wheat selected for cultivation at Pusa. All four varieties yield good straw, and are considerably rust resistant. It is noteworthy that the order of all ten samples, based on baking tests, corresponded exactly with their nitrogen content.

THE economic value of certain Australian pasture grasses forms the subject of an article by Mr. F. Turner, published in the *Kew Bulletin* (No. 1). *Trigonella suavisissima*, a clover-like plant, makes good forage, or may be served as a vegetable; similarly, *Tetragonia expansa*, receiving the name of Warrigal cabbage, may be used in both ways. *Boerhaavia diffusa*, known as hog weed, and *Geranium dissectum* are forage plants bearing fleshy roots that formerly provided food for the aborigines. *Erodium cygnorum* is another herb that in the young succulent stage is much relished by stock. *Calandrinia balonensis* contains moisture as well as nutrition in its succulent leaves, and *Portulaca oleracea* is similar. A plantain, *Plantago varia*, affords good pasture, and *Psoralea tenax* receives the name of native lucerne, while the plant known as nardoo is the hydrophytic fern *Marsilea quadrifolia*.

THE section Gamopetalæ is completed in the twenty-first part of "Materials for a Flora of the Malayan Peninsula," that is reprinted from the Journal of the Asiatic Society of Bengal (vol. lxxiv., extra number, 1908). This part contains the family Gesneriaceæ, for which Mr. H. N. Ridley is responsible, and the family Verbenaceæ, collated by Mr. J. S. Gamble. A large number of new species were described by Mr. Ridley in 1905, to which are now added two new species of *Æschynanthus*, and *Lepidanthus flexurus*, the type of a new genus. *Didymocarpus* is the most important genus as regards the number of species. Several of the genera are confined to the Malayan or Indo-Malayan regions. The diagnoses of several new species in the Verbenaceæ were published in the *Kew Bulletin* for 1908. *Premna*, *Vitex*, and *Clerodendron* are large genera; *Vitex peralata* is noted as an ornamental tree worthy of cultivation.

It may be hoped that the appointment of Mr. N. W. Thomas on the anthropological survey of the Niger delta will not lead to the discontinuance of his "Bibliography of Anthropology and Folk-lore," of which the second annual issue for 1907 has recently appeared, at the modest price of two shillings, under the auspices of the Royal Anthropological Institute and the Folk-lore Society. It deals only with books and periodicals published within the British Empire, with a few references to English publications on countries like China; there is no attempt to include more than prehistoric archaeology, and only unwritten languages are noticed. The range of the compilation is thus limited, but it is useful so far as it goes, and its publication emphasises the urgent need of concerted action. The work is of a kind which should not depend upon the labours of any single worker, however energetic. Surely the societies which deal with the phases of man's life, past and present, might combine to do what the Royal Geographical Society so admirably accomplishes in the bibliography contained in its monthly journal.

MR. A. LANG, in a paper published in vol. iii. of the Proceedings of the British Academy, discusses the origin of the terms of human relationship. He suggests that "own" relations, maternal or paternal at least, were

recognised before the evolution of the family groups into the tribe introduced "tribal" mothers, brothers, and sisters. Then, as tribal law developed, regulating all things by grade of age, the old names for the nearest relationships were simply extended (sometimes with qualifications, such as "elder," "younger," "little") to all persons of the same age-grade, in the same phratry, with the same duties, privileges, and restrictions. He sums up the discussion in the provisional conclusion that the classificatory, widely inclusive terms of relationship prove nothing, neither for nor against a theory of primal promiscuity. The material for these inductions is largely drawn from the Arunta and other Australian tribes, about whom our information is still very incomplete. It is difficult, for instance, to reconcile the accounts of the Arunta given by Messrs. Spencer and Gillen with those of later observers, and Mr. Lang, in his analysis of Australian terms of relationship, depends largely on analogies drawn from Aryan languages. The value of such material interpreted by such methods is obviously small, and our anthropologists would be well advised to defer speculation on the sociology of primitive man in general until the customs and languages of the native Australians, which supply evidence essential to such an inquiry, have been ascertained with much greater certainty.

THE stone implements of the French older Palæolithic age have been recently critically studied by Dr. Hugo Obermaier, with special reference to their stratigraphy and evolution (*Mitteilungen der prähistorischen Kommission der Kais. Acad. der Wiss. Wien*, Band ii., No. 1, 1908, pp. 41-125, 134 figures in text). The relative chronology of forms of implements suggested by G. de Mortillet is confirmed and amplified. Dr. Obermaier's results may be very briefly summarised as follows. An Early Chellian period, devoid of hand-wedge (Faustkeil) implements, was followed by the High Chellian, characterised by its primitive hand-wedge (Urfaustkeil) implement. The Acheulean evolving therefrom must be divided into an older and newer period, as exemplified in the forms of the hand-wedge. The groups of "La Micoque" and "Levallois" are subdivisions of the latter. The hand-wedge is either absent or completely decadent in the Mousterian age. In *Le Préhistorique* (1900) G. and A. de Mortillet state repeatedly that the hand-wedge (*coup de poing*) was the sole implement of the Chellian age, and that the chips of this age are of no significance; but in this they are mistaken, since numerous smaller implements have been recognised; for example, the scraper and blade appear in the Early Chellian, borers and punchers also occur in Chellian deposits, as do a cutting implement with a dressed arched back, and some other tools. The numerous illustrations render this paper indispensable to those who desire to trace the evolution of the various types of flint implements during the earlier phases of the Palæolithic age.

FROM the offices of the Egyptian Survey Department, Ministry of Finance, we have received a copy of a very useful almanac for 1909, which contains much information concerning the various Government and public offices and institutions of Egypt. Under the title of "General Information" we find numerous tables concerning meteorological data, the height of the Nile, the planting and reaping of various crops, and the conversion of weights, measures, and money. The almanac has been compiled by the Survey Department, and is sold for 25 millimes (6¼d.).

MM. FLAMMARION and Loisel give their usual summary of the climatology of the past year (1908) in the February

and March numbers of the *Bulletin de la Société astronomique de France*. The results are founded on the observations made at the Juvisy Observatory, and deal with temperature, pressure, rainfall, insolation, cloudiness, &c. Numerous curves show the daily or monthly march of each element, whilst other curves and tables compare the results with those of previous years since 1886. Comparisons are also made of the seasons, and those having similar meteorological records in different years are grouped together in a very handy form for reference. In a general remark, the observers state that for several years now late summers have been the rule.

THE director of the meteorological observatory, Chemulpo, has sent us the results of the observations made at six Japanese meteorological stations in Korea for each of the months January–December, 1907. The observations are made thrice daily, with monthly summaries, and are a valuable contribution to the meteorology of the Far East. An annual summary would be a very useful addition to the tables, which have been very carefully prepared by Mr. Y. Wada. The instruments and method of observation are the same as those at the meteorological stations in Japan; this is a sufficient guarantee of their accuracy.

THE fifteenth annual report of meteorology in Mysore, for 1907, has been received, containing daily and monthly means for the second-class stations of Bangalore and Mysore, and 8h. a.m. observations and means for the third-class stations of Hassan and Chitaldrug. The altitude of these important stations varies from approximately 2400 feet at Chitaldrug to 3100 feet at Hassan, and they lie at the corners of a quadrilateral of which the diagonal, ninety-seven miles in length, is almost due west, Bangalore, the easternmost station, being 190 miles west of Madras. The observations have been very carefully discussed by Mr. N. V. Iyengar, chief observer in charge, and include mean values for the years 1893–1907. The absolute maxima of shade temperature during that period exceeded  $100^{\circ}$  at all stations, and reached  $103^{\circ}$  at Chitaldrug; the lowest reading was  $42^{\circ} \cdot 7$ , at Hassan. On extreme occasions relative humidity fell to between 4 per cent. and 6 per cent. at the different stations. The mean yearly rainfall varied from 25.6 inches at Chitaldrug to 35 inches at Bangalore.

A CORRESPONDENT, Mr. A. E. H. Bott, of Fishburn, Alberta, asks for information on a matter which is of common interest to many where severe cold is experienced. An ordinary horizontal minimum thermometer filled with coloured alcohol was placed about 6 feet above the ground on the north wall of a house. The instrument registered from  $-60^{\circ}$  F. to  $+114^{\circ}$ . In the early part of January the thermometer registered from  $-35^{\circ}$  to  $-53^{\circ}$  for about six or seven nights in succession. The thermometer was tilted every day in order to replace the index at the end of the thread of alcohol. The thermometer was afterwards left untouched for some days, while the observer was away from home, and it was then found that the colouring matter, apparently the red of cochineal, had entirely left the upper part of the thread, which was now difficult to see. When writing, the top of the column stood at  $+14^{\circ}$ , but the deep-red colour began to pale at about  $-50^{\circ}$ , and faded gradually until it disappeared completely at about  $-14^{\circ}$ . It seems probable that the cochineal was frozen out of the solution, and that the mixture was rather mechanical than chemical. In all probability heating or warming the mixture would restore the instrument to the same condition as when purchased, but a recurrence of the separation of the colouring matter with extreme cold seems probable.

IN the Bulletin of the American Mathematical Society for March, Miss Eva M. Smith discusses some surfaces having a family of helices as one set of lines of curvature. From the investigation it appears that surfaces can exist one set of the lines of curvature of which are general helices defined by constant ratio of curvature and torsion, but no surfaces have regular helices (*i.e.* helices on right circular cylinders) for their lines of curvature.

THE February issue of the Journal of the Institution of Electrical Engineers contains Mr. W. R. Cooper's paper on the tariffs now in force for the supply of electricity for domestic purposes. He considers that their present tendency is to discourage the demand for electricity, and advocates with much force the substitution for them of the payment of a fixed sum per annum based on the number and power of the lamps installed, *plus* a small charge, not exceeding one penny per unit, for the electricity used. In the discussions of Mr. Cooper's paper, which took place in London, Glasgow, and Dublin, widely divergent opinions were expressed by lighting engineers as to the relative merits of the old and the proposed systems, but almost all were agreed that some reform is necessary if the more extensive use of electricity for domestic purposes is to be encouraged.

METALLURGISTS who have not made a special study of the accurate measurement of high temperatures, and who are therefore not in a position to judge of the relative merits of the various determinations of the melting point of iron, will be very grateful to Prof. Carpenter, of Manchester, for a critical summary of our knowledge on the subject, which appears in part iii. of the Journal of the Iron and Steel Institute for 1908. After a brief statement of the relations of the gas, the thermo-electric and the optical temperature scales to each other, Prof. Carpenter gives the results obtained during the last five years by observers at the national physical laboratories of Germany, France, America, and England, and concludes that the freezing point of iron is  $1505^{\circ}$  C. on the thermo-electric temperature scale, which corresponds to  $1519^{\circ}$  C. on the optical scale as at present used.

WE have received eight pamphlets forming appendices to the annual reports of the Coast and Geodetic Survey from 1899 to 1906, which deal with the observational magnetic work carried out in the United States under the supervision of Dr. L. A. Bauer, chief of the division of terrestrial magnetism. These appendices consist largely of observational data, accompanied by descriptions of the stations where the observations were made. Particular care is taken in indicating the exact sites, which are marked with wooden pegs or stone blocks. In addition to observational details there are descriptions of the magnetic observatories of the Survey and their instrumental outfit, as well as of the field instruments. The instruments at the fixed observatories seem mainly of German origin. Of the field instruments, the magnetometers are of a special pattern—a combined magnetometer and theodolite—made in the Survey's workshops. The dip circles—including the ordinary land pattern and the Lloyd-Creak for use at sea—are mostly of English make. Fitted with Lloyd's total-force needles and an auxiliary compass, the dip-circle seems to have proved a very useful universal instrument. The latest of the publications contains an isogonic chart for the United States for the epoch 1905, based on results from some 3500 stations, and it also gives tables of secular change—a good many extending back to 1750—for some eighty stations. Lists of observers in several years include more than thirty names, and it is abundantly clear that



magnetic work has an importance attached to it in the United States to which there is hardly a parallel elsewhere.

A PAPER on the construction and wear of roads, by Mr. H. A. R. Mallock, F.R.S., was read before the Institution of Civil Engineers on March 23. The subject was considered from a theoretical point of view with regard to the foundation of the road, its surface, and the character of the traffic. It was suggested that roads with a hollow cross-section, drained by a central gutter covered by a continuous grating, would be worthy of trial, as tending to prevent the accumulation of mud and water close to the footways, and as giving the greatest facilities for keeping the whole of the roadway clean. The origin of dust and mud on roads is imputed almost entirely to the grinding and crushing action of iron tyres and iron horseshoes. The conclusion drawn from the whole of the evidence is that the chief enemies of good roads are iron tyres and iron-shod horses, or, indeed, any forms of traction which cause very intense local pressure on the road surface. The view was expressed that with soft tyres the wear on any good road is extremely small, and with pneumatic tyres still less, but that so long as iron tyres and iron-shod horses are used for traction, the best means of preserving a clean and unbroken road surface is to be found either in the applications of tar (many of which have already been made with considerable success), or in some other method which will give the same large limits of elasticity and rupture to the upper layer of road material. For roads used exclusively by soft tyres there is a far wider choice of suitable road material than where the surface is exposed to very intense pressure.

A SECOND edition of Dr. M. Abraham's "Elektromagnetische Theorie der Strahlung" has been published by the firm of B. G. Teubner, of Leipzig and Berlin. This work is the second volume of the "Theorie der Elektrizität," reviewed in our issue for August 15, 1907 (vol. lxxvi., p. 377). The price of the present part is 10 marks.

WE note with interest and satisfaction the publication of German editions of two well-known works of science originally published in English. The first is "Habit and Instinct," by Prof. Lloyd Morgan, F.R.S., which has been translated by Maria Semon, and issued by the firm of B. G. Teubner, of Leipzig and Berlin, at the price of 5 marks. The second is Prof. Alexander Smith's "Introduction to General Inorganic Chemistry," translated by Dr. Ernst Stern, and published by the firm of G. Braun, of Karlsruhe.

### OUR ASTRONOMICAL COLUMN.

#### ASTRONOMICAL OCCURRENCES IN APRIL:—

- April 1. 22h. Jupiter in conjunction with the Moon (Jupiter  $3^{\circ} 45' S.$ ).
2. 22h. Saturn in conjunction with the Sun.
3. 9h. 55m. to 11h. 5m. Moon occults  $\nu$  Virginis (mag. 4.2).
10. 9h. 8m. to 12h. 34m. Transit of Jupiter's Satellite III. (Ganymede).
- „ 15h. 52m. to 16h. 32m. Moon occults  $\delta$  Ophiuchi (mag. 4.3).
13. 19h. Mars in conjunction with the Moon (Mars  $2^{\circ} 29' N.$ ).
15. 10h. 30m. to 14h. 46m. Transit of Jupiter's Satellite IV. (Callisto).
19. 9h. 43m. Minimum of Algol ( $\beta$  Persei).
- 19-22. Epoch of Lyrid meteors. (Radiant  $271^{\circ} + 33^{\circ}$ ).
21. Venus. Apparent diameter  $9''.8$ .

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THE ROTATION OF THE SUN.—In a paper appearing in the March number of the *Astrophysical Journal* (vol. xxix., No. 2, p. 110) Prof. W. S. Adams gives and discusses the results obtained during 1908 in the spectroscopical investigation of the sun's rotational velocities. In general, these results agree closely with those obtained during the 1906-7 investigation, although for latitudes greater than  $50^{\circ}$  larger values are now obtained for the velocity; there is no evidence, however, of the existence of a variation of the rate of rotation. Lines of lanthanum and of cyanogen are again found to give low values, as are also two "enhanced" lines investigated. On the other hand, certain lines of manganese and iron indicate high velocities. In general, such abnormal behaviour becomes more marked in the higher latitudes.

The present results were derived from spectrograms taken with the tower telescope and the 30-feet spectro-scope, and show a marked increase of probable accuracy over those obtained with the smaller equipment in 1906-7. They also show that Faye's equation for the rotation holds quite good up to within  $10^{\circ}$  of the poles. Special plates taken with solar vortices in the field show that the vortices may introduce variations of such magnitude as to invalidate any conclusion normally derived from the measures.

Special studies were also made of the behaviour of the calcium line at  $\lambda$  4227 and of the H $\alpha$  line, and it was found that both give high rotational velocities; such abnormalities are explained by the greater height reached by the matter producing these lines. The former line was found to be indubitably double, although the separation of the components is extremely small. The study of H $\alpha$  gave some very interesting results, among which we may mention that at different distances from the limb this line indicates very different velocities; it also shows only a slight equatorial acceleration.

COMMON MOTIONS OF THE PRINCIPAL URSAE MAJORIS STARS.—A number of investigators have discovered evidence of a probable physical connection between the seven principal stars of the constellation Ursa Major, and in Nos. 4313-4 of the *Astronomische Nachrichten* Dr. Lüdendorff again discusses the question on the basis of radial velocities determined at Potsdam.

The radial velocities of  $\beta$ ,  $\epsilon$ , and  $\zeta$  Ursæ Majoris were investigated. In the case of  $\beta$ , the measures indicate a variable velocity with a period of about 27.16 days. The absolute values found for  $\epsilon$  can only be looked upon as approximate, but they indicate a variability of restricted range and long period, the variation being between  $-8$  km. and  $-18$  km., with a period of about 2.1 years. The centre of gravity of the system of  $\zeta$  Ursæ Majoris is shown to have a large range (269 km.) of velocity, with a period of 20.536 days.

Considering together the proper motions and parallaxes of the seven stars, it is found that there are probably two connected systems, system i. including  $\beta$ ,  $\gamma$ ,  $\delta$ ,  $\epsilon$ , and  $\zeta$ , and system ii. including  $\alpha$  and  $\eta$ , both of which have approximately the same parallax and the same velocity relative to the sun, but the angle between the directions of the two systems is about  $101^{\circ}$ .

THE SURFACE OF ROTATING MERCURY AS A REFLECTING TELESCOPE.—Having made a striking series of experiments on the possibilities of the paraboloidal surface of rotating mercury as a reflecting telescope, Prof. R. W. Wood describes and illustrates his results in No. 2, vol. xxix., of the *Astrophysical Journal* (p. 164, March).

Prof. Wood succeeded, by very finely adjusting the motion of his rotating tank, in producing mercury surfaces on which the disturbances were negligible, and for which a constancy of focus could be maintained for some time. Although the experiments appear, at first glance, to be merely of theoretical interest, Prof. Wood is so gratified with the results that he suggests methods whereby results of practical interest might be obtained. One of these is the possibility of taking casts, in some easily fusible material, of sufficient rigidity when solidified to bear electrotypes being made from it. These electrotypes, suitably mounted and silvered, might then be used in reflecting telescopes.

PHOTOGRAPHS OF THE EARTHSHINE ON THE MOON.—Two excellent photographs, showing the greater part of the